Pollution Solutions

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Mark Sweeney
East Texas Council of Governments
3800 Stone Road
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Dear Mark:

Inclosed are two paper copies of the 1996 Emission Inventory (EI) for the Tyler/Longview/Marshall area and a copy in electronic format. I will provide a copy to the TNRCC in paper and electronic format. The inventory will need to be updated to include the biogenic emissions when they are completed by Environ. If you review the inventory you may notice a difference between it and the 1995 inventory. The following is an brief overview of the differences between the two inventories.

As documented in the text of the 1995 inventory and the 1996 inventory, each emission source or group of sources was calculated. The 1996 E.I. is a new inventory. The most accurate method of calculating each emission category was used. Where possible new information was used or developed that was more specific and more accurate. An example of new information developed, is the oil and gas emissions. EPA emission factors were used that are specific to each operation (compressors, heaters, tanks, and equipment leak rates). The 1995 inventory calculated only subsets of these emissions. The largest VOC category, storage of petroleum liquids, was calculated but VOC emissions from fugitive leaks and natural gas dehydration were not quantified. For NOX, compressor emissions were quantified only to the extent that they were identified as minor sources but NOX emissions from heaters were not quantified. Special field studies were used to develop average horsepower per million cubic feet of gas produced, average tank size for oil and natural gas liquids, the average number and type of components leaking, and the average consumption of gas for heating per million cubic feet produced. This process information allowed a calculation of production emissions per process per million cubic feet of gas produced.

Information had been obtained for compressors through the minor source inventory but not for every source. To prevent double counting, the minor source inventory was adjusted by removing oil and gas sources. Other portions of the inventory were also recalculated or based on new data. The end result was that the 1996 inventory had smaller minor source emissions and larger area source emissions.

Although the minimum specification for the 1996 inventory was to use the 1995 inventory and make adjustments using growth factors, it was felt that for purposes of modeling the extra effort

was essential. The result is an improved inventory and more value for the same dollars.

To summarize, the 1996 inventory is a stand alone effort and an improvement over the 1995 inventory. Comparisons for historical purposes are interesting, but due to recalculation of emissions, and adjustments of the minor source inventory, not all categories are directly comparable.

Sincerely,
Pollution Solutions

Jerry M. Demo, P. E.
Principal

cc: Greg Yarwood, Environ

TYLER/LONGVIEW/MARSHALL

FLEXIBLE ATTAINMENT REGION

EMISSION INVENTORY

OZONE PRECURSORS, VOC, NO_X AND CO

1996 EMISSIONS

DECEMBER 1998

PREPARED BY POLLUTION SOLUTIONS
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1.0 BACKGROUND AND EMISSIONS SUMMARY

This document presents the 1996 emissions inventory for reactive volatile organic compounds (VOC) oxides of nitrogen (No_x) and carbon monoxide (CO) from point, area, non-road mobile, on-road mobile, and biogenic sources for the core counties and major sources for perimeter counties in the Tyler/Longview/Marshall Flexible Attainment Region. Also provided are the 1996 stationary point source data from Louisiana DEQ for Caddo, Bossier and DeSoto Parishes.

This is an update of the 1995 Emission Inventory. Where new data or methods were available the emissions were recalculated using this information. If new information was not available for a category the emissions were calculated using a correction factor to convert from 1995 to 1996. Emissions are reported on an annual basis and ozone season, tons per day.

The basic format of this report, as well as its contents, was based on requirements contained in the 1990 Federal Clean Air Act and associated guidelines for the development of a base year emissions inventory provided by the U.S. Environmental Protection Agency. Adjustments were made to accommodate regional distinctions. A copy of the area and non-road mobile emission inventory was provided to the TNRCC in Quattro Pro format to be used to update the National Emission Trends (NET) data base.

1.1 BACKGROUND

The geographic area covered in this inventory is shown in the map at the front of this document. This area included the core counties of Gregg, Harrison, Rusk, Smith, and Upshur. A strict interpretation of the area would be the core county(ies) as well as the area encompassed by a 25-mile radius of surrounding core counties. As can be imagined, a strict 25-mile boundary does not coincide with county or other jurisdiction lines. For the purpose of developing a clearer definition of the planning area boundaries and to avoid unnecessary judgement

calls pertaining to the precise location of particular facilities in relation to the borders, the inventoried boundaries were conservatively defined to include all portions of the surrounding counties.

Different State agencies contributed information to this inventory necessary for preparing emission estimates. The State Comptrollers Office through the Texas Natural Resource Conservation Commission provided 1996 population projection data for the planning area counties. The Texas Department of Transportation (TxDOT) supplied highway vehicle registration data and developed vehicle miles of travel (VMT) estimates and vehicle travel parameters input into the MOBILE emissions model. The MOBILE emissions model was run by the Texas Transportation Institute. The Texas Natural Resource Conservation Commission (TNRCC) provided growth factors, information from their point source inventory, solid waste disposal site information, public owned wastewater treatment facility information, accidental release and spill information, and remediated storage tank information.

1.2 EMISSIONS SUMMARY

Consistent with the 1990 emissions inventory guidelines, stationary point sources of VOC emissions of ten tons per year or greater and NO_x and CO sources of 25 tons or greater were included in the inventory. Emissions totals are expressed as 1996 values using data for 1996, whenever available. The starting point for point source estimates was the existing TNRCC Point Source Data Base (PSDB) which contains process and emissions data submitted through inventory questionnaires and new source permit applications. This data base was updated by the TNRCC with questionnaire surveys distributed to major (100 tons per year) point sources during 1997. The surveys were structured using the guidelines in the EPA document **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**. Minor source emissions from the 1995 Emissions Inventory were used and updated from information obtained from the TNRCC.

Area and non-road mobile source totals were based on current population, employment, and local activity data. Where activity data was used it was generally combined with emission factors from EPA's **Compilation of Air Pollution Emission Factors. Volume I: Stationary Point and Area Sources. AP-42 (fourth edition)(AP-42)**, **Procedures for the Preparation of Emission**

Inventories for Carbon Monoxide and Precursors of Ozone. Volume I, and the **Procedures for Emissions Inventory Preparation. Volume IV: Mobile Sources** to yield emissions totals. Growth factors were used on a few sources to convert from 1995 to 1996 emissions.

The TNRCC contracted with the Texas Transportation Institute (TTI) to provide on-road emission inventories. The TTI used 1996 VMT and 1997 vehicle registration gathered from TxDOT. On-road vehicle emissions were estimated by applying EPA emission factors from the MOBILE5a_h model to VMT estimates.

Biogenic emissions were to be done by Environ. They will be added to this report at a later date.

Table 1-1 at the end of this section is the Emission Inventory Summary for 1996 by county and major category for this project.

2.0 POINT SOURCES

2.1 INTRODUCTION AND SCOPE

For the purposes of this inventory, point sources are defined as stationary, commercial or industrial operations that emit more than 10 tons per year of VOC or 25 tons per year of NO_x and CO. Point sources are broken down into two subsets, major sources and minor sources. Major sources are sources that emit a criteria pollutant at an emission rate greater than 100 tons per year and are part of the TNRCC state wide emission inventory system. Minor sources are everything not identified as major. In order for the Tyler/Longview/Marshall inventory to be equal in approach and quality to a 1990 base year type ozone Nonattainment inventory minor point sources were added.

2.2 MAJOR SOURCES

2.2.1 METHODOLOGY AND APPROACH

As part of the statewide emissions inventory major industrial sources in the Tyler/Longview/Marshall area were inventoried by the TNRCC in 1996. The same inventory methodology, with minor improvements, created for the 1990 base year inventory was used. The major point source inventory consists of actual emissions for 1996. The TNRCC provided the list of major sources that is part of their PSDB.

2.2.2 QUALITY ASSURANCE MEASURES

In order to maintain the quality of data at the level submitted in the 1990 base year inventory, the same quality assurance measures developed for that inventory were used in the 1996 inventory.

2.2.3 SUMMARY OF POINT SOURCE EMISSIONS

Table 2-1 at the end of this section reflect the major point source emissions for 1996 by source, and total county emissions for the core counties.

Table 2-2 at the end of this section reflects the major point source emissions for 1996 by source and total county emissions for the perimeter counties.

2.3 MINOR SOURCES

2.3.1 METHODOLOGY AND APPROACH

Minor source emissions were obtained by taking currently TNRCC inventoried minor sources and adding additional sources found by the 1995 emission inventory study. The TNRCC provided a list of minor sources that is part of their PSDB. Minor source emissions were calculated excluding emissions from oil and gas industries. These emissions were accounted for in the area source calculations.

3.0 AREA SOURCES

3.1 INTRODUCTION AND SCOPE

In the area source portion of the emissions inventory, emissions were collected for those sources and activities that were too small and/or too numerous to be handled individually in the point source inventory. This is an update of the 1995 Emission Inventory to a base year of 1996. Where new data or methods were available the emissions were recalculated using this information. If new information was not available for a category the emissions were calculated using a correction factor to convert from 1995 to 1996. Emissions are reported on an annual basis and ozone season, tons per day. Area sources of VOC, NOx, and CO emissions were identified by using a list of sources provided by the TNRCC. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I** was used as a guide on how to calculate emissions. The TNRCC was consulted on many of the area source emission calculations. Emission sources are divided into two groups characterized by the emission mechanism: 1) evaporative emissions, and 2) fuel combustion emissions.

Sources of evaporative losses include gasoline service station operations, solvent use in dry cleaning, degreasing, surface coating operations, and leaking underground storage tanks. Fuel combustion sources include stationary source fossil fuel combustion, structural fires, and solid waste disposal. Table 3-1 lists each area source category included in this report. Included in this report are descriptions of each category, methodology used to estimate emissions, sources of data, and emission factors used.

3.2 METHODOLOGY AND APPROACH

Methodologies used for estimating the area source activity levels and emissions came primarily from two EPA sources: **Procedures for the Preparation of Emissions Inventories for Precursors of Carbon Monoxide and Ozone, Volume I**, and **AP-42** (Fifth edition). Some categories were researched to obtain more accurate methods of calculation of emissions. The seasonal adjustment factors to calculate the ozone season emissions in tons per day came from **Prodedures - ,Volume I** or as noted in the text. Additional information was provided by Texas state agencies, including the Texas Railroad

Commission (TRC), the TNRCC, and the Department of Parks and Wildlife (TP&WD). County population numbers used for calculating emissions from specific categories were provided by the State Comptrollers Office. These numbers reflect the 1996 projected population. Table 3-1a list the population used. For the purposes of this study most calculations were rounded to one-hundredth of a ton/yr and one-ten thousandth of a ton/day. If the source was less than .01 ton/yr they were not included in the inventory.

Table 3-1
Area Source Categories

COMBUSTION (HEATING & COOKING)
FUEL OIL-INDUSTRIAL/DISTILLATE
FUEL OIL-INDUSTRIAL/RESIDUAL
NATURAL GAS-INDUSTRIAL
LPG-INDUSTRIAL
FUEL OIL-COMMERCIAL/DISTILLATE
FUEL OIL-COMMERCIAL/RESIDUAL
NATURAL GAS-COMMERCIAL
LPG-COMMERCIAL
COAL, ANTHRACITE-RESIDENTIAL
COAL, BITUMINOUS-RESIDENTIAL
FUEL OIL-RESIDENTIAL/DISTILLATE
FUEL OIL-RESIDENTIAL/RESIDUAL
NATURAL GAS-RESIDENTIAL
LPG-RESIDENTIAL
WOOD/RESIDENTIAL FIREPLACE

BAKERIES

OIL & GAS PRODUCTION
COMPRESSOR COMBUSTION EMISSIONS
FUGITIVE FROM NATURAL GAS COMPRESSOR STATIONS
NATURAL GAS DEHYDRATION(GLYCALC) EMISSIONS
NATURAL GAS LIQUIDS STORAGE
CRUDE OIL STORAGE
INDUSTRIAL PROCESSES: NEC

COATING (PAINTING) OPERATIONS
ARCHITECTURAL COATINGS
AUTO REFINISHING
TRAFFIC MARKINGS
FACTORY FINISHED WOOD
WOOD FURNITURE
METAL FURNITURE
PAPER
METAL CONTAINERS
METAL COILS
MACHINERY & EQUIPMENT
LARGE APPLIANCES
ELECTRICAL EQUIPMENT

MOTOR VEHICLES
AIRCRAFT
MARINE COATINGS
RAILROAD
OTHER PRODUCT COATINGS
HIGH-PERFORMANCE MAINT.
OTHER SPEC. PURPOSE COATINGS

DEGREASING
SURFACE CLEANING COLD CLEANING - GENERAL
DRY CLEANING
DRY CLEANING - GENERAL

GRAPHIC ARTS
ADHESIVES APPLICATION: INDUSTRIAL
CUTBACK ASPHALT
EMULSIFIED ASPHALT
PESTICIDE APPLICATION

CONSUMER/COMMERCIAL SOLVENT USE
CONSUMER/COMMERCIAL SOLVENT USE-GENERAL

MARINE VESSEL LOADING LOSSES

SERVICE STATIONS
SERVICE STATIONS - TANK TRUCK UNLOADING
SERVICE STATIONS - VEHICLE REFUELING
SERVICE STATIONS - OTHER
SERVICE STATIONS - TANK BREATHING LOSSES
SERVICE STATIONS - TANK TRUCKS IN TRANSIT

WASTE DISPOSAL
OPEN BURNING
MUNICIPAL WASTE LANDFILLS
MUNICIPAL WASTEWATER TREATMENT (POTW)
LEAKING UNDERGROUND TANKS

FIRES
FOREST WILDFIRES
SLASH BURNING
PRESCRIBED BURNING
STRUCTURE FIRES
CATASTROPHIC/ACCIDENTAL RELEASES

Table 1a County Populations 1996

County	Population
Gregg	109298

Harrison	62796
Rusk	46313
Smith	165599
Upshur	33482

3.3 QUALITY ASSURANCE MEASURES

Quality Assurance (QA) procedures for area sources rely mainly upon the quality of data used for each separate category. Data such as current population figures, fuel usage, and material usage routinely change annually. Sources of this information were contacted during the inventory for updates. Current EPA documents were also obtained to keep abreast of changes in emission factors. Other routine efforts such as checking calculations for errors, and conducting reasonableness and completeness checks were implemented.

3.4 SUMMARY OF AREA SOURCE EMISSIONS

Area sources in the Tyler/Longview/Marshall area were responsible for the release of 47235.24.86 tons/yr and 129.6952 tons/day of VOC, 14424.26 tons/yr and 39.5526 tons/day of NOx and 12431.49 tons/yr and 11.6762 tons/day of CO during the 1996 year.

Tables 3-2 through 3-6 show the area source emissions by specific categories for each county in the study area.

3.5 DISCUSSION OF AREA SOURCE CATEGORIES

This section provides a listing of the area source categories with a description of the source, the methodology and emission factors used to calculate emissions, and sources of data.

3.6 OIL AND GAS PRODUCTION

3.6.1 Introduction

Emissions considered in this category come from crude oil and natural gas production in each County in 1996. The production information was obtained from the Oil & Gas Division of the Railroad Commission of Texas. Minor sources were excluded to allow for uniform treatment of emissions based on total oil and gas production.

3.6.2 Methodology

It was assumed, that the crude oil and natural gas condensate that was produced, was stored in a tank at the production site before it was transported off site to a processing plant. A survey was conducted and it was ascertained that the average size storage tank was approximately 8,820 gallons. The production in each county was divided by the **net throughput** of the average tank. This would provide the number of tanks in that county. The number of tanks was multiplied by the emissions per tank to obtain the tons of VOC emissions for crude oil and condensate. The emissions per tank was obtained by using the EPA Tanks 31 program. This is in lieu of surveying each tank at every production site.

For Natural gas production there are fugitive emissions from leaking components in gaseous and light liquid service, combustion emissions from heaters, combustion emissions from compressors used to transfer the natural gas into production lines, and the VOC emissions from the dehydration of Natural Gas. Surveys were done to estimate the average number of components in gas and liquid service, quantify the range and average horsepower of compressors, BTU rating of heaters, and use of heaters. Heater use includes gas dehydration and in line heating. Process emissions were then calculated using average values of gas produced per well site. Total emissions for a county was obtained by multiplying the emissions per typical well site times total county production divided by typical production per well site.

3.6.3 Example Calculations crude/ condensate storage

A) Crude and Condensate Storage

The following were the input parameters for the crude oil Tanks 31 calculations: Vertical fixed roof, shell height 15 ft, diameter 10 ft, liquid

height 15 ft, avg. liquid height 8 ft, volume 8,820 gallons, turnovers per year 12, shell color/shade gray/light, shell condition good, roof color/shade gray/light, roof condition good, roof height 1 ft, roof radius 11 ft, mixture/component crude oil (working loss was doubled to compensate for truck filling emissions). The average gallons calculated per tank/year is 98712.

Example Calculation

Total VOC emissions from Tanks31 = 2.80376 tons/yr per tank for crude oil.

The example county Gregg produced 19,006,545 barrels of oil
Times 42 gallons/barrel divided by 98712 gal per tank/yr = 192.55 tanks
192.55 tanks/yr x 2.80376 tons/yr = 401.22 tons/yr of VOC emissions. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

B) Compressor Emissions

Compressor emissions were based on 11 gm/hp-hr for NOX, 1.5 gm/hp-hr for CO, and 0.43 gm/hp-hr for NMHC and 139.75 hp/mmscf/day production of gas. The total production for each county in million cubic feet per day was multiplied by 139.75 to ascertain the average operating horsepower. The operating horsepower was then multiplied by the emission factor for each emission component to calculate annual tons of NOX, NMHC, and CO.

Example Calculation

An example county (Gregg) had 61,988,980 mcf of production. 61,988,980 mcf/(1000 mscf/mmscf)/365 days/yr times 139.75 daily hp/mmscf times 11 gm/hp-hr times (8760 hrs/yr)/ 454 gm/lb /(2000 lbs/ton) = 2518.75 ton/yr NOX for the example county. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

C) Dehydrator Emissions

Dehydrator emissions were based on the emission program GLYCALC and the characteristics of natural gas produced in the Tyler-Longview-Marshall area. Different gas has different fractions other than methane. A study was

conducted to determine the average amount of VOC lost per mmcf of gas produced. For the sample of gas wells studied, the VOC was determined to be 7.909 lbs VOC/mmscf. This was then applied to gas production for each county to determine VOC emissions. Combustion emissions are separately calculated and shown as part of the heater emissions.

Example Calculation

An example county (Gregg) had 61,988,980 mcf of production. 61,988,980 mcf/1000 mscf/mmscf times (7.90951 lbs/mmscf)/(2000 lbs/ton) = 245.15 ton/yr VOC. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

D) Heater Emissions

Heater emissions were based on the emission factors in AP-42 and the number of combustion sources for the typical natural gas well site in the Tyler-Longview-Marshall area. In line heaters are used , heaters are a part of the dehydration process, and heaters are used in conjunction with amine treaters. Emissions were based on 100 lb/mmscf for NOX, 84 lb/mmscf for CO, and 5.5 lb/mmscf for VOC. Average production per well site was 977.33 mmscf/yr. The average heat consumption per 997.33 mmscf/yr was 4.443 mmBTU/hr. Each counties production was divided by the typical well site production and multiplied by 8760 hours per year and divided by 1000 scf/mmbtu.

Example Calculation

An example county (Gregg) had 61,988,980 mcf of production. 61,988,980 mcf/(1000 mscf/mmscf)/ (977.33 mmscf/yr per typical well site) times (4.443 mmbtu/hr per typical well site) times (8760 hrs/yr)/ (1000 mcf/mmbtu) times(100 lbs NOX/mmscf)/(2000 lbs/ton) = 123.43 ton/yr NOX for the example county. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

D) Fugitive Emissions

Fugitive emissions were based on the emission factors in AP-42 and the number of components in liquid and gas service for the typical natural gas well site in the Tyler-Longview-Marshall area.

VALVES	GAS	0.0045	PUMP	GAS	0.0024

	HV OIL	8.4E-06	SEALS	HV OIL	NA
	LT OIL	0.0025		LT OIL	0.013
	H20/OIL	9.8E-05		H20/OIL	2.4E-05
OTHERS	GAS	0.0088	CONNECTORS	GAS	0.0002
	HV OIL	3.2E-05		HV OIL	7.5E-06
	LT OIL	0.0075		LT OIL	0.00021
	H20/OIL	0.014		H20/OIL	0.00011
FLANGES	GAS	0.00039	OPEN LINES	GAS	0.002
	HV OIL	3.9E-07		HV OIL	0.00014
	LT OIL	0.00011		LT OIL	0.0014
	H20/OIL	2.9E-06		H20/OIL	0.00025

For the sample of wells studied, the number of components was as follows: 22 valves, 13 relief valves, 4 compressor seals, 40 flanges, 26 liquid valves, 2 open lines, and 2 pump seals. A spread sheet with the above emission factors times the number of components was developed. This resulted in a composite emission factor of 0.42 t/y per well site. This composite emission factor includes a reduction in total organics calculated to the percentage VOC (9.07%). This eliminated methane from emissions totals. The number of producing wells was multiplied by this factor for each county.

Example Calculation

An example county(Gregg) had 455 production wells. 455 wells times 0.42 t/y per typical well site) = 191.1 ton/yr VOC for the county. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

3.6.4 References

1. **Oil and Gas Well Production**, Texas Railroad Commission, Austin, TX.
2. **AP-42, U. S. Environmental Protection Agency, 5th ed., January 1995,**
3. **TANKS31 program, U.S. Environmental**

3.7 GASOLINE DISTRIBUTION

3.7.1 Introduction

The Gasoline Distribution category is divided into appropriate subcategories due to different emission factors necessary to calculate VOC emissions.

3.7.2 Tank Truck Unloading

Tank truck unloading refers to the transfer of fuel from the tank truck to the service station tank. The VOC emission rate is affected by the method of filling (balanced or submerged).

3.7.3 Vehicle Refueling

VOC emissions from refueling result from the displacement of vapors from the vehicle fuel tank by dispensed gasoline. The quantity of displaced vapors depends on gasoline temperature, gasoline Reid Vapor Pressure (RVP), and dispensing rate.

3.7.4 Tank Breathing Losses

Emissions from VOC storage tanks are vapors from the tank liquid and may vary due to temperature and tank configuration.

3.7.5 Tank Trucks in Transit

VOC breathing losses from tank trucks in transit are caused by leaking delivery trucks, pressure in the tanks, and thermal effects on the vapor and liquid.

3.7.6 Other Losses

VOC emissions from spillage have been separated from the other categories.

3.7.7 Diesel

Voc emissions were also calculated for diesel fuel. In each case the result was less than 0.01 t/y. These emissions are less than the significance level and were not included.

3.7.8 Methodology

VOC emissions from all sources of the Service Station category were calculated by applying emission factors to the number of gallons of fuel processed for 1996. The emission factors used are as follows:

Tank Truck Unloading	7.1 lb/1000 gal
Tank Truck Unloading balanced	0.3 lb/1000 gal.

Vehicle Refueling	11.0 lb/1000 gal.
Tank Breathing Loss	1.0 lb/1000 gal.
Tank Trucks in Transit	0.12 lb 1000 gal.
Other (spillage)	0.7 lb/1000 gal.

Emission factors used came from AP-42 and were applied to 1996 gasoline sales for each county(obtained from the State Comptrollers Office).

Tank truck unloading is based on RVP of 8.0 for gasoline the emission factor for tank truck unloading was recalculated using AP-42. RVP 8.0 is a true vapor pressure (P) of 4.5 psig.

3.7.9 Example Calculation

Calculating the tank truck unloading (all categories are calculated in the same manner) factor:

LL = 12.46 SPM / T
LL = Loading loss in lb/1000 gal.
S = Saturation factor (1)
P = True vapor pressure (4.5)
M = Molecular weight (67)
T = Temperature (68 deg. F + 460)
LL =(12.46)(1)(4.5)(67)/(460 + 68) = 7.1 lb/1000 gal
Calculating tank truck unloading:
Gasoline sales for an example county(Gregg) =54,547 thousand-gal. in 1996
VOC TPY = 54547 m-gal. Times
7.1 lb/m-gal/2000 lbs/ton = 193.64 tons per year

The seasonal adjustment factor is 1 and the activity days per week is 6 to yield tons per day.

3.7.10 References

1. **Compilation of Air Pollution Emission Factors. Volume I: Stationary Point and Area Sources. AP-42 5th ed.**, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, January, 1995.
2. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.8 MARINE VESSEL LOADING LOSSES

3.8.1 Introduction

There are no sources in this category in the study area therefore no emissions were calculated.

3.9 LEAKING UNDERGROUND STORAGE TANKS

3.9.1 Introduction

This is a category for the 1996 Emissions Inventory dealing with old underground VOC storage tanks that have been unearthed for removal.

3.9.2 Methodology

The number of underground storage tank removals for each county was obtained from the Petroleum Storage Tank Division of the TNRCC. The following tables shows the number of tanks removed in each county.

Remediated Tanks in 1996	
County	Tanks
Gregg	113
Harrison	37
Rusk	19
Smith	30
Upshur	29

The emission factor of 28 lbs/day of VOC emissions per event was supplied by Radian Corporation under contract to the EPA Office of Air Quality Planning and Standards. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

3.9.3 Example Calculation

Tanks removed in Smith County in 1996 = 30
Activity Days per event = 5

(30)(28) lbs per day = 840 lbs.
(840 / 2000)(5) = 2.10 TPY of VOC
(2.10)(1/365) = 0.0058 TPD of VOC

3.9.4 References

1. **Memorandum: VOC Emissions from Leaking Underground Storage Tanks**, Radian Corp., Research Triangle Park, NC, May, 1992.
2. **List of Underground Storage Tanks Removed in 1996**, Texas Natural Resource Conservation Commission, Austin, Texas, August, 1998.

3.10 SURFACE COATINGS

3.10.1 Architectural Coatings

3.10.1.1 Introduction

Architectural surface coatings, or paints, are used primarily by homeowners and painting contractors to coat the interior and exterior of houses and buildings and on the surfaces of other structures such as pavements, curbs, and signs.

3.10.1.2 Methodology

A per capita emission factor of 4.6 lb/capita was used to calculate VOC emissions from architectural surface coatings.

The emission factor was based on information from EPA's **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**. County populations came from the TNRCC.

3.10.1.3 Example Calculations

Gregg county 1996 population = 109,298
109,298 x 4.6 lb. VOC per person = 502770.8 lbs.
502770.8 lbs / 2000 lbs/ton = 251.39 TPY

The seasonal adjustment factor is 1.3 and the activity days per week is 7 to yield tons per day.

3.10.1.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.10.2 Automobile Refinishing

3.10.2.1 Introduction

Automobile refinishing is the repainting of automobiles, light trucks, and other vehicles. It does not include surface coating during manufacturing.

3.10.2.2 Methodology

A per capita emission factor of 2.3 lb/capita was used to calculate VOC emissions from automobile refinishing.

The emission factor and activity days were based on information from EPA's **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**. County populations came from the TNRCC.

3.10.2.3 Example Calculation

One county 1996 population = 109,298
109,298 x 2.3 lb. VOC per person / 2000 = 125.69 TPY

The seasonal adjustment factor is 1.0 and the activity days per week is 5 to yield tons per day.

3.10.2.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.10.3 Traffic Markings

3.10.3.1 Introduction

This category deals with the VOC emissions resulting from the evaporation of organic solvents during and shortly after the application of traffic paints used to mark pavement. Examples of these markings include the dividing lines to denote traffic lanes, lines to mark parking spaces, crosswalks, and so on.

3.10.3.2 Methodology

These VOC emissions will be estimated by multiplying the county population by an EPA supplied emission factor of 0.5 lbs. per year per capita as seen in Table 4.3-6, p. 4.24 of the **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I: General Guidance for Stationary Sources**.

3.10.3.3 Example Calculations

One county (Gregg)has a population of 109,298.
109,298 x .5 /2000 = 27.32 TPY
The seasonal adjustment factor is 1.0 and the activity days per week is 5 to yield tons per day.

3.10.3.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I: General Guidance for Stationary Sources**, No. EPA-450/4-91-016, U.S. Environmental Protection Agency, May 1991.
2. **Projections for County Populations,** data provided by TNRCC Emission Inventory staff.

3.10.4 Industrial Surface Coatings

3.10.4.1 Introduction

Surface coatings are applied to a wide variety of products, such as the categories listed below, and are almost entirely considered point sources, and their emissions are documented in the point source section. However, in order to collect data from smaller sources that may not be reported as point sources, these categories were included as area sources.

3.10.4.2 Methodology

Per employee emission factors were used, for the most part, in calculating the emissions from these categories. Where SIC information was not available a lbs per capita number was used to estimate emissions. The emission factors for each category are from EPA's **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**. County populations came from the TNRCC. The categories and their lbs/year per employee emission factors are:

Category	SIC Code(s)	Lbs./Yr. Per Employee
Furniture and Fixtures	25	944
Machinery and Equipment	35	77
Factory Finished Wood	2426-9, 243-245, 2492, 2499	131
Electrical Insulation	3357, 3612	290

Other industrial coatings categories were investigated and the results are as follows: Metal furniture, Metal coils, Paper coating, Large Appliances, Automobile manufacturing, Other Product coatings, High Performance coatings and other Special purpose coatings were not identified as active (none were found). Metal Container, and Railcar coating sources were included as a part of the point source inventory.

3.10.4.3 Example Calculation

Gregg county's 1995 employment in Machinery & Equipment SIC code 35 is 2449.
Machinery and Equipment emission factor = 77 lb. per employee, Adjustment to 1996 = 1.060527
2449 employees x 77 lb. VOC per person times year factor 1.060527 divided by 2000 lb/ton= 100 TPY
The seasonal factor is 1 and the activity days per week are 5 for the daily emissions.

3.10.4.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May 1991.

2. **County Business Patterns, 1996, Texas**, Internet, U. S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census.

3.11 BAKERIES

3.11.1 Introduction

The primary VOC emitted by the baking process is ethanol, which is formed by the yeast fermentation of bread and dough while it is baking. Although it is a natural, biological process emission, the emissions are significant. Small bakeries are also important because although small in, individual emissions, there are a large number per capita.

3.11.2 Methodology

The starting point of the calculation of emissions in this category was the American Institute of Baking estimate of per capita consumption of bread and related products. The per capita consumption is 76.67 lbs. per person per year. Based on this consumption rate, calculations of emissions were made as suggested in the April 24, 1992 Radian memo, "VOC Emissions from Bakeries" by Lucy Adams. A per capita emission rate of .383 tpy/1000 people was derived. That figure is multiplied by per 1000 people of county population. Research for minor source inventory indicates there is a large number of small bakeries. Because of this the lbs/capita factor was used. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

3.11.3 Example Calculations

Gregg county has a population of 109298.

(109298)(0.383/1000 TPY) = 41.86 TPY of VOC
(41.86)(1/365) = 0.1147 TPD of VOC

3.11.4 References

1. Adams, Lucy; "VOC Emissions from Bakeries", Radian Corporation, April 24, 1992.

TABLE

Per Capita Consumption of Bread and Related Products	

Product	Pounds Per Person
Breads	**49.87**
White Pan	27.92
Variety Types	21.95
Rolls	**22.81**
Hamburger and hot dog	13.30
Bagels, all types	2.99
Brown and serve	1.35
Hearth	1.38
English muffins	1.68
Croissants	.48
Other bread type rolls	1.63
Sweet Yeast Goods	**3.99**
Doughnuts	1.50
All other	2.49
Total	**76.67**

Note: Estimates and forecasts by U.S. Department of Commerce, International Trade Administration (ITA)
Source: U.S. Industrial Outlook 1992--Food and Beverages

3.12 CATASTROPHIC/ACCIDENTAL RELEASES

3.12.1 Catastrophic/Accidental Releases (Spills)

3.12.1.1 Introduction

There are a variety of types of oil spills (eg. tanker spills, tanker truck spills, pipeline ruptures and so on). Similarly, there are just as many types of fuels that are spilled, each with its particular evaporative qualities. Other factors affecting emissions are the time that it takes to clean up the spill (if it is cleaned up), weather, and whether or not the oil spill catches fire.

The information that is available, from the TNRCC simply lists the material spilled (crude, gasoline, diesel, ammonia, wastewater, etc.), where it was spilled, when, and amount spilled. Given the information, our calculations of emissions will, of necessity, be simple and direct also.

3.12.1.2 Methodology

We have the amounts from each spill. A TNRCC chemist has estimated that 10% of the weight of crude lost will evaporate; 20% of gas well liquid (condensate) and diesel will evaporate; 100% of the gasoline will evaporate. The number of gallons lost (after conversion from barrels) will be multiplied by 7 lbs./gal (density of crude), by 6.5 lbs./gal. (approximate density of condensate) 6 lbs/gal (for diesel), and 5.5 lbs/gal (for gasoline). The pounds will then be converted to TPY. The emissions for each spill were added together for each county. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

3.12.1.3 Example Calculation

In 1996, 50 Gallons of diesel was spilled in Harrison County. Employing the methodology described above, the emissions would be estimated this way:
(50 gallons)(0.2) = 10 gallons evaporated
(10 gallons)(6 lbs./gal/2000) = 0.03 TYP of VOC
(0.03)(1/365) = 0.0001 TPD of VOC

3.12.1.4 Summary

The study area had 38132.16 gallons of VOC containing materials spilled in 1996. This calculated to 63.70 ton/yr of VOC emissions. See the tables starting with Table 3-2 for complete, county by county, breakdowns of emissions.

3.12.1.5 References

1. TNRCC, Emergency Response Unit MC 142, 12124 Park 35 Circle, Austin, Texas 78753;. TNRCC file of Spills for a site by date

3.13 SURFACE CLEANING OPERATIONS

3.13.1 Introduction

Degreasing operations employing cold solvent cleaning are used to remove grease, fats, oil, wax, or soil from the surface of metal, glass, or plastic articles.

3.13.2 Methodology

EPA's **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I** separate this degreasing category into two major and two minor subcategories. However, since the "per capita" method of calculating emissions was used, the total factor of 4.3 was applied.

3.13.3 Example Calculation

Gregg county 1996 population = 109,298
109,298 x 4.3 lb. VOC/person/2000 lbs./ton = 234.99 TPY. The seasonal factor is 1 and the activity days per week are 6 for the daily emissions.

3.13.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.14 DRY CLEANING

3.14.1 Introduction

Emissions from dry cleaning facilities are most recently thought to come predominantly from the mineral spirits (naphtha) used in the dry cleaning process.

The EPA emission factor of 1.8 lb/capita was reduced based on 1991 TNRCC Rule Effectiveness Study. The EPA calculated emission is reduced by 73.75% because perchlorethylene a nonVOC has been used as a replacement for naphtha.

3.14.2 Methodology

A per capita emission factor of 1.8 lb/capita was used to calculate VOC emissions. The activity days per week are five. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I** was the source of the emission factor, as well as the activity days, and county populations came from the TNRCC.

3.14.3 Example Calculation

Gregg 1996 population = 109,298
109,298 x 1.8 lb. VOC per person
Divided by 2000 lbs/ton = 98.37 tons per year
98.37 x (1 - 0.7375) = 25.82 tons per year.
Daily emissions have a seasonal variation of 1 and activity days of 5.

3.14.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May 1991.

2. **Texas Air Control Board FY 91 Rule Effectiveness Study Draft Final Report**, TACB Dallas/Ft Worth Region Staff, Fort Worth, Texas (817) 732-5531.

3.15 GRAPHIC ARTS

3.15.1 Introduction

The printing industry includes the printing of newspapers, books, magazines, fabrics, and other materials.

3.15.2 Methodology

A per capita emission factor of 1.3 lb/capita was used to calculate VOC emissions from graphic arts facilities. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I** was the source of the emission factor and county populations came from the TNRCC.

3.15.3 Example Calculation

Gregg county 1996 population = 109,298
109,298 x 1.3 lb. VOC per person /2000 lb/ton
= 71.04 tons per year. Daily emissions have a seasonal adjustment of 1 and activity days of 5.

3.15.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.16 ASPHALT

3.16.1 Introduction

The two types of asphalt paving used for road paving and repair are cutback asphalt and emulsified asphalt.

Cutback asphalt is a type of liquefied road surface that is prepared by blending or cutting back asphalt cement with various kinds of petroleum distillates. It is used as pavement sealant, tack coat, and a bonding agent between layers of paving material. Cutback asphalt is divided into 5 grades (MC30, MC800, MC3000, MC2400, and RC250). The different grades have a range of distillate from 5% to 40%. The emissions were distributed by the percent purchased of these grades.

Emulsified asphalt is used in the same applications as cutback asphalt. However, instead of blending asphalt cement with petroleum distillates as in cutback asphalt, emulsified asphalt use a blend of water with an emulsifier, which is generically referred to as soap.

3.16.2 Methodology

Emissions for asphalt usage was calculated using growth factors from the 1995 data because the Texas Department of Transportation (TxDOT) did not have any records on the amount of asphalt used in the East Texas study area. The growth factor for Gregg county is 1.03471 and the growth factor for the other 4 counties is 1.0353. TxDOT is only keeping these records in ozone non-attainment areas for the TNRCC. The TNRCC needs to make a special request to TxDOT so that this information is available in the East Texas study area for future studies.

3.16.3 References

1. Darren Hazelit, Texas Department of Transportation, Austin, Texas, 512-232-1902.
2. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.17 CONSUMER/COMMERCIAL SOLVENT

3.17.1 Introduction

Consumer and commercial products include household products, toiletries, aerosol products, rubbing compounds, windshield washing fluids, polishes and waxes, nonindustrial adhesives, space deodorants, moth control products, and laundry detergents and treatments. Organics in these products may act either as the carriers for the active product ingredients or as the active ingredients themselves. The Organics may be released to the atmosphere through immediate evaporation of an aerosol spray, evaporation after application, or direct release in the gaseous phase.

3.17.2 Methodology

A per capita emission factor of 6.3 lb/capita was used to calculate VOC emissions from consumer/commercial solvent use. EPA's **Procedures for the Preparation of Emissions Inventories for Precursors of Ozone. Volume I** was the source of the emission factor. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

3.17.3 Example Calculation

Gregg County's 1996 population = 109298
(109,298)(6.3 lb. VOC per person) = 688577.4 lbs.
(688577/2000) = 344.29 TPY of VOC
344.29/365 = 0.9433 TPD of VOC

3.17.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.18 PESTICIDE APPLICATION

3.18.1 Introduction

Pesticides are defined as any substance used to kill or retard the growth of insects, rodents, fungi, weeds, or microorganisms. Pesticides used in the home and garden are included as part of the consumer/commercial solvent use category.

3.18.2 Methodology

An emission factor of 3.5 lb. (averaged from the recommended 2-5 lbs.) per harvested acre was used to calculate VOC emissions from pesticide application. The factor was applied to each county's total harvested acreage.

EPA's **Procedures for the Preparation of Emission Inventories for Precursors of Ozone. Volume I** provided the emission factor, as well as the seasonal adjustment factor and activity days per week. The seasonal adjustment factor is 1.3 and the activity days per week is 6 to yield tons per day. The harvested acres for each county came from the web site of the USDA - National Agricultural Statistics Service, http://www.usda.gov/nass.

Harvested Acres in 1996	
County	Acres
Gregg	3000
Harrison	2000
Rusk	2000
Smith	12000
Upshur	2000

3.18.3 Example Calculation

Gregg County 1996 acres harvested =3000
(3000 acres)(3.5 lb. VOC per acre) = 10500 lbs.
(10500 / 2000) = 5.25 TPY VOC
(5.25)(1.3 /312) = 0.0219 TPD VOC

3.18.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.
2. **USDA - National Agricultural Statistics Service.**

3.19 MUNICIPAL WASTE LANDFILLS

3.19.1 Introduction

Emissions from landfills are produced by three mechanisms: volatilization, chemical reaction, and biological decomposition of liquid and solid compounds into other chemical species.

3.19.2 Methodology

VOC emissions were calculated using the EPA - Landfill Air Emissions Estimation Model, Version 1.0. The following is a definition of terms and the values used in the model:

M_{NMOC} = mass emission rate of non methane VOC, Tons per year
L_O = methane generation potential = 125 m^3/Mg
R = average annual acceptance rate, Mg/yr
k = methane generation rate constant = 0.04 yr^{-1}
t = age of landfill, years
C_{NMOC} = concentration of NMOC = 1170 ppm by vol. as hexane
3.6 x 10^{-9} = conversion factor
1.1023 tons = 1 Mg

The TNRCC Municipal Solid Waste Division provided data on refuse acceptance rate tonnage for 1995. The modeled answer was multiplied times a growth factor of 1.02999 for Gregg County. The Growth factor for the other 4 counties is 1.0144. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

3.19.3 Example Calculation

Average Annual waste acceptance rate for Gregg County 1995 = 70825 Mg/yr
Age of landfill = 20 years

Model calculated emission rate 1995 = 45.27 TPY VOC
(45.27)(1.02999) = 46.63 TPY VOC
(46.63)(1/365) = 0.1277 TPD VOC

3.19.4 References

1. "Municipal Solid Waste Division Permit Application Database Information, TNRCC

2. **AP-42, Volume I,** Fifth Edition, US Environmental Protection Agency, Section 2.4
3. **40CFR60, New Source Performance Standards, Supart WWW**
4. **EPA - Landfill Air Emissions Estimation Model**

Version 1.0.

3.20 WASTE TREATMENT EMISSIONS

3.20.1 Publicly Owned Treatment Works (POTW)

3.20.1.1 Introduction

POTW are those entities owned by municipalities, school districts, trailer parks, municipal utility districts (MUD), and so on that have been charged with handling the wastewater discharge, or influent, from industries, from wastewater collection systems, and other miscellaneous sources. It is estimated that industry's contribution to the total annual flow is about 16%.

3.20.1.2 Methodology

Information was provided by the TNRCC Wastewater Permits Section on daily average flows (in thousands of gallons) and number of months operated for each POTW in 1996 in counties in the study area. The daily average flows were multiplied by number of days operated. This was summed to arrive at the total 10^3 gallons treated in each county. Total 10^3 gallons were multiplied by .16 (industry's contribution to the total flow). This number, in turn, was multiplied by an emission factor from Procedures Volume I of 0.11 lbs. of VOC per 10^3 gallons of wastewater. The product of this multiplication was divided by 2000 to convert to tons per year of VOC. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

POTW Influent By County
East Texas Area

County	Gallons 10^3
Gregg	88608.63
Harrison	138006.93
Rusk	697.96

Smith	6029.03
Upshur	311.24

3.20.1.3 Example Calculation

Gregg County had 88608.63 X 10^3 gallons of annual wastewater flow

.

(88608.63)(0.16)(0.11 /2000) = 0.78 TPY VOC
(0.78)(1/365) = .0021 TPD VOC

3.20.1.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I: General Guidance for Stationary Sources**, U.S. Environmental Protection Agency, Publication No. EPA-450./491-016, p. 3-14, May 1991 edition.
2. TNRCC Waste Water Permits Section

3.21 SOLID WASTE INCINERATION

3.21.1 On-Site Incineration

On-site incineration of solid waste includes the burning of leaves, landscape refuse, or other refuse or rubbish by residential, commercial/institutional and industrial sources. The TNRCC Regulation I very strictly regulates all forms of open burning and is very prohibitive in allowing any burning to occur. Open burning that is allowed is discussed in the "Open Burning" category.

3.21.2 Open Burning

3.21.2.1 Introduction and Methodology

As is noted in the EPA document **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone Volume I: General Guidance for Stationary Sources**, there is little information available concerning open burning. Therefore, the suggested method is to calculate emissions by assuming 450 tons burned per 1000 people per year. this factor is provided in Table 4.6-2, p. 4-38 of the EPA

document. Emission factors were obtained from AP-42 (VOC = 30 lbs./ton of municipal refuse; NO_x = 6 lbs./ton; CO = 85 lbs./ton).

There is some guidance on the subject of open burning provided by the Texas laws regulating the practice. A paraphrasing of the Health and Safety Code is that open burning is not permitted in any Texas city or any county with a population of 30,000 or more. The practice in Texas, however, is that even in the exempt counties trash pick-up is available. Therefore, it is concluded that a worst-case analysis of open burning is that it would be confined to those counties with populations of 30,000, or less, and that it would be practiced by a small number of rural farm people in a county. It was assumed that 10% of the county population is rural farm for this category. A list of those counties in the area with populations less than 30,000 and their respective estimated rural farm populations follows:

County	**Population**	**Rural Farm Population**
Gregg	109,298	10,300
Harrison	62,796	30,000
Rusk	46,313	29,000
Smith	165,599	68,000
Upshur	33,482	24,000

3.21.2.2 Summary

None of the actual Tyler/Longview/Marshall counties are below the threshold population of 30,000 and all have both municipal and county (rural) trash pick-up mandated by Texas law. No emissions are reported for open burning pending a study of compliance with open-burning regulations.

3.21.2.3 References

1. **Vernon's Texas Code, Annotated**, Health and Safety Code, Part I, Chapter 3, Section 363.113, 1992.
2. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I: General**

Guidance for Stationary Sources, U.S. Environmental Protection Agency, Publication No. EPA-450/4-91-016, p. 4-38, May 1991 edition.

3.22 SMALL STATIONARY SOURCE FOSSIL FUEL USE

3.22.1 Fuel Oil Consumption

This subcategory consists, in turn, of five subheadings that further define the groups consuming fuel oil products. These are: Residential Distillate Consumption, Commercial/Institutional Distillate Consumption, Commercial/ Institutional Residual Consumption, Industrial Distillate Consumption and Industrial Residual Consumption.

3.22.1.1 Residential Distillate Consumption

3.22.1.1.1 Introduction

In the state of Texas, only distillate oil is consumed in residences and the quantity consumed is low. It is low for at least two reasons: the most important reason is that Texas is a major natural gas producer so natural gas is the fuel most often used for residential heating. Secondly, for the most part, winters are not severe in Texas and regardless of the type of fuel used consumption is low as a consequence. Previous work done by the TNRCC indicates that this category is insignificant.

3.22.1.1.2 Methodology

The 1990 consumption statewide was 126,000 gallons. Energy Information Association (EIA) information indicates similar patterns for 1996. Emissions were not calculated because of insignifica

nt fuel usage.

3.22.1.2 Commercial Distillate Consumption

3.22.1.2.1 Introduction

The total amount of distillate fuel oil consumed by commercial operations in Texas in 1995 is estimated to be 58,823,529 gallons.

3.22.1.2.2 Methodology

Allocation, when only statewide consumption information is available, often means developing some reasonable proportional apportionment scheme. The strategy in this subcategory is to make the assumption that it is reasonable to allocate based on numbers of employees in the commercial SIC codes. The statewide consumption figure available from the Energy Information Administration (EIA) is for SIC codes 50-87, and 89. Numbers of employees by SIC code per county are available from Census publications for the year 1995. The number of gallons is multiplied by the number of employees per county for SIC codes 50 -89. That figure is, in turn, divided by the total number of employees in the SIC codes statewide to make each county's consumption proportionate in the same manner that SIC total county employment is to SIC code total state employment. The gallons per county are then multiplied by a growth factor of 1.0054 to convert from 1995 to 1996 usage. The converted gallons are multiplied by the emission factors from AP-42 which are: VOC = 0.2 lb/1000 gal.; NOx = 20 lbs/1000 gal and CO = 5 lb/1000 gal. The number of pounds is converted to TPY by dividing by 2000. The seasonal adjustment factor is 0.6 and the activity days per week is 6 to yield tons per day.

Commercial Distillate Consumption 1996

County	Num of Emp. SIC 50-87 + 89	Distillate 10^3 gallons
Gregg	34,384	432.84
Harrison	7,588	95.52

Rusk	4,714	59.34
Smith	44,012	554.06
Upshur	2,953	37.17

3.22.1.2.3 Example Calculation

Gregg County has 34,384 employees in SIC codes 50-87 and 89.
(58,823.53 10^3 gals)(34384 employees)/(4,697,983 statewide employees)(1.0054) = 432.84 10^3 gallons
(432.84 10^3)(0.2 lb/10^3 gal)/2000 = 0.04 TPY VOC
(0.04)(0.6)/312 = 0.0001 TPD VOC

3.22.1.2.4 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdowns of emissions.

3.22.1.3 Commercial Residual Consumption

3.22.1.3.1 Introduction

Use of residual quality fuel by commercial operations in Texas is even smaller in numbers of gallons than in use of distillate. Energy Information Administration (EIA) estimates indicate that 2,982,000 gallons were used statewide in 1990.

3.22.1.3.2 Methodology

Emissions were not calculated because of insignificant fuel usage.

3.22.1.4 Industrial Distillate Consumption

3.22.1.4.1 Introduction

This was reported as point source emissions only. No emissions were calculated for area sources.

3.22.1.5 Industrial Residual Consumption

3.22.1.5.1 Introduction

This would be reported as part of the point source emissions. No emissions were calculated for area sources.

3.22.2 Coal Consumption

3.22.2.1 Residential Coal Consumption

3.22.2.1.1 Introduction

No reported usage of coal for home heating in 7 county area. No emissions were calculated for area sources.

3.22.2.2 Commercial Coal Consumption

3.22.2.2.1 Introduction

Commercial coal use is insignificant. The annual usage for 1990 reported by EIA was only 7,000 tons. This same usage trend was seen in 1996. This amount spread over county proportions of 4,697,983 statewide employees in SIC codes 50-87 and 89 results in insignificant emissions for the 5 county area. Emissions reported are zero.

3.22.2.3 Industrial Coal Consumption

3.22.2.3.1 Introduction

This would be reported as part of the point source emissions. No emissions were calculated for area sources.

3.22.3 Natural Gas Consumption

3.22.3.1 Residential Natural Gas Consumption

3.22.3.1.1 Introduction

There were 215,00 million cubic feet of natural gas consumed in Texas during 1995 by 3,060,161 residential users.

3.22.3.1.2 Methodology

The natural gas usage for each county was calculated by multiplying state wide gas usage by the ratio of homes using gas in a county to total homes using gas in the state. The 10^6 cubic feet per county is then multiplied by a growth factor of 1.0010 to convert from 1995 to 1996 usage.

The cubic feet are then multiplied by an emission factor and converted to TPY by dividing the product by 2000. The seasonal adjustment factor is 0.3 and the activity days per week is 7 to yield tons per day. Emission factors are: VOC = 5.5 lb/10^6 cubic feet; NO_x = 94 lb/10^6 cubic feet and CO = 40 lb/10^6 cubic feet.

Residential Natural Gas Comsumption 1996

County	households using gas	Gas use 10^6 scf
Gregg	21482	1510.79
Harrison	10087	709.40
Rusk	7223	507.98
Smith	26710	1878.46
Upshur	4043	284.33

3.22.3.1.3 Example Calculation

Gregg County has 21,482 natural gas customers:
((215,000)(21482)/(3,060,161))(1.0010) = 1510.79 X 10^6scf
(1510.79 X10^6)(5.5/10^6)/2000 = 4.15 TPY VOC
(4.15)(0.3)/365 = 0.0034 TPD VOC

3.22.3.1.4 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdowns of emissions.

3.22.3.2 Commercial Natural Gas Consumption

3.22.3.2.1 Introduction

Statewide consumption of natural gas by commercial establishments in Texas in 1995 was estimated by EIA at 218,000 million cubic feet.

3.22.3.2.2 Methodology

The statewide consumption is to be allocated to each county based on the number of employees in the commercial SIC codes (50-87 and 89).

The statewide number of employees in these SIC codes was 4,697,983 in 1995. The number of million of cubic feet of gas will be multiplied by the county number of commercial employees then divided by the state number of commercial employees. The 10^6 cubic feet per county are then multiplied by a growth factor of 0.9976 to convert from 1995 to 1996 usage. The converted cubic feet will by multiplied by an emission factor then divided by 2000 to convert it to TPY. The emission factors are: VOC = 5.5 lb/10^6 cubic feet; NO_X = 100 lbs/10^6 cubic feet and CO = 84 lbs/10^6 cubic feet.

Commercial Natural Gas Consumption 1996

County	Num of Emp. SIC 50-87 + 89	Natural Gas 10^6 scf
Gregg	34,384	1591.69
Harrison	7,588	351.26
Rusk	4,714	218.22
Smith	44,012	2037.38
Upshur	2,953	136.70

3.22.3.2.3 Example Calculation

Gregg County has 34,384 employees in the commercial SIC codes.
[(34384 x 218,000 X 10^6)/4,371,116](0.9976) = 1591.76 X 10^6 scf
(1591.76)(5.5 lb/10^6 ft^3)/2000 = 4.38 TPY VOC
(4.38)(0.6)/312 = 0.0084 TPD VOC

3.22.3.2.4 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdowns of emissions.

3.22.3.3 INDUSTRIAL NATURAL GAS CONSUMPTION

3.22.3.3.1 Introduction

This would be reported as part of the point source emissions. No emissions were calculated for area sources.

3.22.4 Liquid Petroleum Gas Consumption

3.22.4.1 Residential LPG Consumption

3.22.4.1.1 Introduction

The statewide consumption of liquid petroleum gas (LPG) by 473,529 residential users in Texas during 1995 was estimated by EIA at 120,000 X 10^3 gallons.

3.22.4.1.2 Methodology

The LPG usage for each county was calculated by multiplying statewide LPG usage by the ratio of homes using LPG in a county to total homes using LPG in the state. The 10^3 gallons per conty are then multiplied by a growth factor of 0.9893 to convert from 1995 to 1996 usage.

The cubic feet are then multiplied by an emission factor and converted to TPY by diving the product by 2000. The season adjustment factor in 0.3 and the activity days per week is 7 to yield tons per day. Emission factors are: VOC = 0.4 lb/10^3 gal.; NO_x = 15 lbs/10^3 gal and CO = 2.1 lbs/10^3 gal. Please note that the higher factors for butane were used since no information is available as to whether the LPG is butane, propane, or a mixture of both.

Residential LPG Consumption 1996

County	Households using LPG	LPG use 10^3 Gallons
Gregg	1322	331.44
Harrison	2416	605.70
Rusk	3014	755.63
Smith	5755	1442.81
Upshur	2184	547.54

3.22.4.1.3 Example Calculation

Gregg County has 1322 households that use LPG for home heating. The 120,000 X 10^3 gallons of LPG that were consumed statewide will be allocated this way:
(1322 Gregg/473,529 TX)(120,000 X 10^3 gal.)(0.9893) = 331.44 X 10^3 gal
(331.44 X 10^3)(0.4 lb/10^3 gal)/2000 = 0.07 TPY VOC
0.07 X .3/365 = 0.0001 TPD VOC

3.22.4.1.4 Summary

See the tables starting with Table 3-2 for a complete, county by county, breakdown of emissions.

3.22.4.2 Commercial LPG Consumption

3.22.4.2.1 Introduction

The statewide consumption by commercial businesses in Texas of LPG during 1995 was 80,000 x 10^3 gallons according to the EIA.

3.22.4.2.2 Methodology

Statewide consumption of LPG will be allocated to each county according to county numbers of employees in Commercial SIC codes (50-87 and 89). The total number of employees in Commercial SIC codes statewide was 4,697,983. The number of 10^3 gallons will be multiplied by the county's number of Commercial employees then divided by the statewide number of Commercial employees. The 10^3 gallons per county are then multiplied by a growth factor of 0.9976 to convert from 1995 to 1996 usage. The number of gallons will then be multiplied by an emission factor then divided by 2000 in order to convert from pounds to tons. The seasonal adjustment factor is 0.6 and the activity days per week is 6 to yield tons per day. Emission factors are: VOC = 0.4 lb/10^3 gal; NO_x = 15 lb/10^3 gal and CO = 2.1 lb/10^3 gal. Please note that the higher emission factors for butane are being used since no information is available as to whether the LPG consumed was butane, propane, or a mixture of both.

Commercial LPG Consumption 1996

County	Num of Emp. SIC 50-87 + 89	LPG 10^3 gallons

Gregg	34,384	584.10
Harrison	7,588	128.90
Rusk	4,714	80.08
Smith	44,012	747.66
Upshur	2,953	50.17

3.22.4.2.3 Example Calculation

Gregg County had 34,384 employees in commercial SIC codes. Statewide consumption of 80,000 x 10^3 gallons will be apportioned to the county this way:
(80,000 x 10^3 gal)(34384 employees/4,697,983 Statewide employees)(.9976) = 584.10X 10^3 gallons
(584.10 X 10^3)(0.4 lb/10^3gal)/2000 = 0.12 TPY VOC
(0.12)(0.6)/312 = 0.0002 TPD VOC

3.22.4.2.4 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdowns of emissions.

3.22.4.3 Industrial LPG Consumption

3.22.4.3.1 Introduction

The statewide consumption of LPG in Texas for Industrial uses during 1995 was 10,001,600 x 10^3 gallons estimated by the EIA,.

3.22.4.3.2 Methodology

The statewide consumption is to be allocated to each county based on the number of employees in the industrial SIC codes 1-39 (since the total state consumption figure is for all those SIC codes). The statewide number of employees in these SIC codes was 1,629,521 in 1995. The statewide consumption of 10^3 gallons will be multiplied by the county number of employees then divided by the state number on employees. The 10^3 gallons per county are then multiplied by a growth factor of 1.0152 to convert from 1995 to 1996 usage. The converted 10^3 gallons will be multiplied by and emission factor then divided by 2000 to convert it to TPY. The seasonal adjustment factor is 1 and the activity

days per week is 6 to yield tons per day. The emission factors are: VOC = 0.4 lb/10^3 gal; NOx = 21 lb/10^3 gal and CO = 3.6 lb/10^3 gal.

Industrial LPG Consumption 1996

County	Num of Emp. SIC 1-39	LPG 10^3 gallons
Gregg	18,174	113243.07
Harrison	4,326	26955.52
Rusk	2,990	18630.84
Smith	16,251	101260.77
Upshur	995	6199.90

3.22.4.3.3 Example Calculation

Gregg county has 18,174 employees in the industrial SIC codes 1-39.
(10,001,600 X 10^3 gal)(18174 Co. emp. /1,629,521 St emp)(1.0152) = 113243.07 X 10^3 gals.
(113243.07 X10^3)(0.4 lb/10^3)/2000 = 22.64 TPY VOC
(22.64)(1/312) = 0.0726 TPD VOC

3.22.4.3.4 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdowns for emissions.

3.22.5 Wood Consumption

3.22.5.1 Residential Wood Consumption

3.22.5.1.1 Introduction and Methodology

The burning of wood for home heating is calculated by a formula available from Procedures, Vol. I, pp. 4-42. The formula requires the following information:
NHUHW = number of housing units heating with wood
HDG =heating degree days (2055 for East Texas area)

ARPH = average room per housing unit (five rooms)
The formula is:
Residential wood use (TPY) = .0017 x NUHW x HDG x ARPH/5.0
This number is multiplied by a growth factor of 1.0008 to convert from 1990 to 1996 usage.

Residential Wood Use in the East Texas Study Area

County	Households Using Wood	Wood use Ton/day
Gregg	481	1681.71
Harrison	859	3003.32
Rusk	982	3433.36
Smith	1325	4632.59
Upshur	953	3331.97

Source: 1990 US Census Data, www.census.gov.
Wood use has been converted to 1996 usage rates

After obtaining TPY of wood used, that number will be multiplied by an emission factor. The number of pounds is converted to TPY by dividing by 2000. The seasonal adjustment factor is 0.3 and the activity days per week is 7 to yield tons per day. The emission factors are: VOC = 53 lbs/ton; NO_x 2.8 lb/ton and CO = 230.0 lbs/ton. The factors used are for Conventional Stoves since no information is available on specific types of stoves used.

3.22.5.1.2 Example Calculation

Gregg County has 481 households using wood for home heating and the county is in a region where there are 2055 heating degree days a year. The average number of rooms per housing unit in the area is five.

(.0017)(481)(2055)(5/5)(1.0008)=1681.71 tons wood
(1681.71)(53 lb/ton)/2000 = 44.57 TPY VOC
(44.57)(0.3/365) = 0.0366 TPD VOC

3.22.5.1.3 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdowns of emissions.

3.22.6 References

1. **Department of Energy/Energy Information Administration DOE/EIA, www.eia.doe.gov**
2. **U.S. Bureau of the Census, www.census.gov**
3. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I**, Publication No. EPA-450/4-91-016, U. S. Environmental Protection Agency, OAQPS, Research Triangle Park, NC, May 1991.
4. **AP-42, Fifth Edition, Volume I**, U. S. Environmental Protection Agency.

3.23 STRUCTURE FIRES

3.23.1 Introduction

Building fires can produce large amounts of emissions over a short period of time.

3.23.2 Methodology

Emissions were derived from an assumption of SIX fires per 1000 people with a fuel loading factor of 6.8 tons per fire. The derived factors of 0.000224 tons/capita for VOC, 0.000029 tons/capita for NO_X and 0.001224 tons/capita for CO, was used. The seasonal adjustment factor is 1 and the activity days per week is 7 to yield tons per day.

EPA's **Procedures for the Preparation of Emission Inventories for Precursors of Ozone. Volume I** provided the emission factors.

3.23.3 Example Calculation

Gregg county 1996 population = 109,298
(109298)(0.000224 tons VOC per capita) = 24.48 TPY VOC
24.48 X 1/365 = 0.0671 TPD VOC
The NOx and CO emissions were calculated the same way.

3.23.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone. Volume I**, EPA-450/4-91-016, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, May, 1991.

3.24 FOREST FIRES

3.24.1 Introduction

Forest fires, or wildfires, in Texas consumed a large number of acres in 1996. There are several governmental agencies responsible for fire protection, maintenance of refuges, and fire reporting in Texas: U.S. Forest Service, Texas Forest Service, U.S. Fish and Wildlife, and National Park Service. The information from the Texas forest Service was used to calculate emissions because they had the most complete set of data for the East Texas area. There were three types of vegetation, Nonforest, Natural Forest and Planted Forest.

3.24.2 Methodology

The procedure for annual emissions is to multiply total annual acreage burned in county by type times the fuel loading factor then multiply that product by an emission factor, obtained from AP-42. The procedure for ozone season daily emissions is to multiply acreage burned in June, July and August in each county by type times the fuel loading factor then multiply that product by the emission factor divided by 92 days. The fuel loading factors supplied by the Texas Forest Service are: 3 tons/acre for Nonforest, 15 tons/acre for Natural Forest and 25 tons/acre for Planted Forest. The emission factors are: VOC's: 24 lbs./ton, NOx: 4 lb./ton, and CO: 140 lb/ton.

TOTAL ACRES BURNED 1996

County	Nonforest	Natural Forest	Planted Forest
Gregg	131	613	0
Harrison	484	1629	862
Rusk	1157	2377	912
Smith	655	1350	18
Upshur	312	572	45

ACRES BURNED JUNE, JULY & AUGUST 1996

County	Nonforest	Natural	Planted

		Forest	Forest
Gregg	0	13	0
Harrison	2	32	0
Rusk	3	70	0
Smith	15	25	3
Upshur	1	7	0

3.24.3 Example Calculation

The Texas Forest Service reports that in 1996 in Gregg county fires consumed 131 acres of nonforest, 613 acres of natural forest and 0 acres of planted forest. They also reported that in June, July and August in 1996 in Gregg County fires consumed 0 acres of nonforest, 13 acres of natural forest and 0 acres of planted forest.
[(131 acres)(3 tons/acre)+(613 acres)(15 tons/acre)+
(0)(25 tons/acre)](24 lb/ton) = 115.06 TPY VOC
[(0)(3)+(13)(15)+(0)(24)](24)/92 days = 0.0254 TPD VOC

3.24.4 Summary

See the tables starting with Table 3-2 for complete, county by county, breakdown of emissions.

3.24.5 References

1. AP-42 U.S. Environmental Protection Agency, 5th Edition, Section 13.1
2. Mahlon Hammetter, Texas Forest Service, (409) 639-8120.

3.25 SLASH BURNING AND PRESCRIBED BURNING

3.25.1 Slash Burning

3.25.1.1 Introduction

This type of burning is a forest management tool and consists of deliberately set fires to burn the slash (waste logs, in order to prepare the underlying ground for new tree planting.

3.25.1.2 Methodology

The county acreage will be multiplied first by a fuel loading factor for slash burning of 15 tons per acre. The "loaded acres" will then be multiplied by emission factors from AP-42,. The emission factors used are: VOCs 12.8 lbs/ton, NO_x 0.46 lb/ton and CO 224 lb/ton.

3.25.1.3 Example Calculation

No emissions were calculated because information needed, acres burned, was not available from any Federal or State agency.

3.25.2 Prescribed Burning

3.25.2.1 Introduction

Prescribed burning is also a forest management tool, but its primary purpose is to clear not only waste logs, but also underbrush that may serve as a host for destructive insects. Since the source of fuel is obviously not as dense as logs the Fuel Loading Factor for material that is burned is far lower: 3 tons per acre.

3.25.2.2 Methodology

The methods employed to calculate emissions from prescribed burning is identical with those described above. The only difference is the Fuel Loading Factor of three tons per acre.

3.25.2.3 Example Calculation

No emissions were calculated because information needed, acres burned, was not available from any federal or State agency.

3.25.2.4 References

1. **Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Vol. I: General Guidance for Stationary Sources**, U.S. Environmental Protection Agency, No. EPA-450/4-91-016, May 1991.
2. Mahlon Hammetter, Texas Forest Service, College Station, Texas (409) 639-8120.
3. **AP-42,** U.S. Environmental Protection Agency, Fifth Edition, Section 13.1

4.0 NON-ROAD MOBILE SOURCES

3.26 INTRODUCTION AND SCOPE

The base year for non-road mobile sources is 1996. Four categories were considered in Non-Road Mobile Sources. They are aircraft, marine vessels, locomotives, and small engines. Aircraft emissions were based on activity data from the Texas department of Transportation, Aviation Division. Locomotive emissions relied upon data from the Railroad Commission of Texas (RCT). Small Engines and marine vessel emissions were extrapolated from previous TNRCC work.

3.27 METHODOLOGY AND APPROACH

Methodologies used for estimating the non-road mobile source activity levels and emissions came from EPA's **Procedures for Emission Inventory Preparation. Volume IV: Mobile Sources**, 1992, AP-42, and previous studies from the TNRCC.

3.28 QUALITY ASSURANCE MEASURES

Quality assurance procedures for non-road mobile sources rely mainly upon the quality of data used for each separate category. Data such as current population figures, fuel usage, and operational events routinely change annually. Sources of this information were contacted during the inventory process for updates. Current EPA documents were obtained to keep abreast of changes in emission factors. Other routine efforts such as checking

calculations for errors and conducting reasonableness and completeness checks were implemented.

3.29 SUMMARY OF NON-ROAD MOBILE SOURCE EMISSIONS

Total non-road mobile emissions from the five core Tyler/Longview/Marshall area counties were 9424.50 tons/yr and 37.9982 tons/day of VOC, 4874.58 tons/yr and 16.4862 tons/day of NO_x, and 46786.54 tons/yr and 228.0419 tons/day of CO during the 1996 study year.

Table 4-1 through 4-5 show the non-road mobile source emissions by specific categories for each county in the area.

3.30 DISCUSSION OF NON-ROAD MOBILE SOURCE CATEGORIES

This section provides a listing of the non-road mobile source categories with a description of the source, the methodology and emission factors used to calculate emissions, and sources of data.

4.30.1 AIRCRAFT EMISSIONS

4.30.1.1 Introduction

Aircraft emissions were divided into 3 categories: commercial aircraft, general aviation, military aircraft, with aircraft refueling a separate category. Emission factors or models were used as appropriate to estimate emissions from each category.

4.30.1.2 Methodology

Commercial:
Methodology
Emission were calculated based upon the distribution and frequency of use (landing and takeoff data from each airport by aircraft type). This data was input into the EDMS model and the appropriate emissions of VOC, NOX, and CO were a model output. For the Longview-Tyler-Marshall Area the Gregg County airport had commercial flights. Model inputs were 35 landing -take off cycles for a Boeing 727.

Military Aircraft:
Methodology
Emission were calculated based upon the distribution and frequency of use (landing and takeoff data from each airport by aircraft type). This data was input into the EDMS model and the appropriate emissions of VOC, NOX, and CO were a model output. For the For the Longview-Tyler-Marshall Area the Gregg County had military flights. Model inputs were 6350 landing -take off cycles for C-130 aircraft. Tyler (Smith County)and Henderson (Rusk County) had some military trainers. They were input into the EDMS model as King Air 200 aircraft based upon discussion with each airport.

4.30.1.3 Example Calculations

General Aviation:
Gregg County, airport had 81960 LTOs for general aviation. The EPA emission factors for general aviation are: THC = 0.394 lb. per LTO, NO_x = 0.065 lb. per LTO, and CO = 12.014 lb. per LTO.
Seasonal Adjustment Factor = Uniform
Activity Days = 7
81960 x 0.394 / 2000 = 16.15 tons of THC per year
Voc = 0.9649 times 16.15 tons THC = 15.58 t/y VOC
15.58 / 365 = .0427 tons per day of VOC
81960 x 0.065 / 2000 = 2.66 tons of NO_x per year
2.66 / 365 = 0.0073 tons per day of NO_x
81960 x 12.014 / 2000 = 492.33 tons of CO per year
492.33 tons / 365 = 1.3488 tons per day of CO

4.30.1.4 References

1. **Procedures for the Emission Inventory Preparation Volume IV: Mobile Sources**, EPA 450/481-026d, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N. C.
2. "**Engine Emissions Data Base**," Federal Aviation Administration.
3. **Airport Activity Statistics of Certified Route Carriers**, Federal Aviation Administration.
4. Airport Master Record, Federal Aviation Administration, 1992.
5. **EDMS Emissions and Dispersion Modeling, System Version 3.0, 1998**, U.S. Department of Transportation, Federal Aviation Administration.

4.30.2 AIRCRAFT REFUELING

4.30.2.1 Introduction

The VOC emissions were calculated for the loading of Jet-A fuel into commercial aircraft, Jet-A fuel into military aircraft and aviation fuel into civilian aircraft. VOC emissions result when the refueling displaces the vapor-laden air in a partially empty fuel tank.

4.30.2.2 Methodology

Fuel data was obtained for the commercial airports in Texas. Aviation fuel was separated into Jet-A used for jet engines and turboprops, and into "100-no lead" that is used for the reciprocating engines.

For Jet-A, an emission factor (EF) was calculated from equation 1, paragraph 4-4-5, AP-42. The equation is shown below:

$$EF = \frac{12.46\ SPM\ \text{lbs - VOC}}{T\quad 1000\ \text{gal. of fuel}}$$

S = 1.45 (Table 4.4.1, *AP-42*)
P = 0.0085 = True psia (Table 4.3.2, *AP-42*)
M = 130 = Mol. wt. (Table 4.3.2, *AP-42*)
T = Temp. Degrees R = 460° + 60° = 520°

$$EF = 12.46\ \left(\frac{1.45 \times 0.0085 \times 130}{520}\right)$$

$$EF = 0.038\ \frac{\text{lb. - VOC}}{1000\ \text{gal}}$$

For General Aviation fuel AP-42 emission factors were used (11 lbs/1000 gal). This is the emission factor for Vehicle Refueling that is used for gasoline transfers.

In addition to the methodology described above, another method was employed to estimate emissions from very small civilian airports. From the amount of fuel transferred into civilian aircraft at the larger commercial airports, it was determined that 1.75 gal/Landing Take-Off was an average factor that could be used to calculate fuel usage due to refueling of the reciprocating type of engines.

4.30.2.3 Example Calculation

Gregg County:

Jet-A = 537,869 gal/yr
+
AVGAS = 143,813 gal/yr

$$VOC = \frac{537{,}869\ \text{gal.}}{1000\ \text{gal}} \times \frac{0.038\ \text{lb}}{2000\ \text{lb}} \times \text{Ton} = 0.0102\ \text{TPY}$$

$$VOC = \frac{143{,}813\ \text{gal.}}{1000\ \text{gal}} \times \frac{11\ \text{lb}}{2000\ \text{lb}} \times \text{Ton} = 0.79\ \text{TPY}$$

The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

Small Airport Example Calculation:

Marshall Airport has 11,400 LTO

$$VOC = \frac{1.75 \text{ gal}}{\text{LTO}} \times \frac{11{,}400 \text{ LTO}}{\text{Yr}} \times \frac{11 \text{ lb}}{10^3 \text{ gal}} \times \frac{\text{Ton}}{2000 \text{ lb}} = 0.11 \text{ TPY}$$

4.30.2.4 References

1. **Procedures for the Emission Inventory Preparation Volume IV: Mobile Sources**, EPA 450/481-026d, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N. C.
2. "**Engine Emissions Data Base**," Federal Aviation Administration.
3. **Airport Activity Statistics of Certified Route Carriers**, Federal Aviation Administration.
4. **AP-42, U. S. Environmental Protection Agency, 5th ed., January 1995.**

4.30.3 MARINE VESSELS

4.30.3.1 Introduction

Marine vessels include large cargo and passenger ships, oil tankers, tugboats, and other steamships and motorships that use fuel oil and diesel as fuels. There are no Marine Vessel emissions in the Tyler/Longiew/Marshall area.

4.30.3.2 Methodology

Since there are no marine vessels in the area, no emissions were calculated.

4.30.4 LOCOMOTIVE EMISSIONS

4.30.4.1 Introduction

There were three Class I railroad operating in the study area in 1996. The three railroads are: (1) Union Pacific Company, (2) Burlington Northern Santa Fe Railway Company, (3) Kansas City Southern Railway Company.

Complete information concerning railroad operations in Texas proved to be difficult to receive. Although Texas has a regulatory agency for railroads, the Railroad Commission of Texas(RCT), the reporting requirements of the RCT do not include the types of information that are needed to calculate emissions. For instance, although the EPA guidance document (**Procedures, Volume IV**) states that railroads collect information on Gross Ton Mileage (GTM) by county in fact most do not (and this information is not required by the RCT either). Needless to say, in some cases this lack of hard information impacts the methodology of the study because other methods must be used to allocate fuel consumption by county.

Information was obtained from the RCT that gave the miles of track of a rail line segment in each county, the estimated trains per day on that rail line segment, and the average number train engines for the rail line segment. The Union Pacific Co. provided the average number of gallons of fuel per mile per engine.

4.30.4.2 Methodology

The method was to simply calculate the number of miles traveled per engine and multiply that time the average number of gallons per mile per engine to arrive at the gallons used in each county. Calculation, then, just amounted to multiplying the gallons by emission factors from Table 6-1, p. 204 of the **Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources**[i]. These factors are: HC = .0211 lbs/gal; NO_x = .4931 lbs/gal and CO = 0.0626 lbs/gal. Hydrocarbon numbers are converted to VOC numbers by multiplying by 1.005, as suggested by the Procedures, Vol. IV manual.

4.30.4.3 Example Calculation

In Gregg county there is 17 miles of track on the Union Pacific rail line segment that runs between Dallas and Shreveport. That track is used 16 times per day with and average of 3.5 engines per train. The track is used 6 days per week or 312 days per year.
17 miles x 16 trains x 3.5 engines/train x 3.5 gallons/mile/engine x 312 = 1,039,584 gals of fuel 1,039,584 x .0211 x 1.005/2000 = 11.02 ton/yr VOC
11.02/312 = 0.0353 ton/day VOC
1,039,584 x .4931/2000 = 256.31 ton/yr Nox
256.31/312 = 0.8215 ton/day NOx
1,039,584 x 0.0626/2000 = 32.54 ton/yr CO
32.54/312 = 0.1043 ton/day CO

4.30.4.4 Summary

See Tables starting with Table 4-1 for complete, county by county, breakdowns of emissions.

4.30.4.5 References

1. **Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources**, U.S. Environmental Protection Agency, Publication No. EPA-450/4-81-026d(Revised), 1992, Table 6-1, p. 204.
2. **Michael Jones, Railroad Commission of Texas**, Rail Division, 512-463-7191.
3. **Ed McCaddon, Union Pacific Co.,** Maintenance and fuel use Section, 402-271-2344.

4.30.5 Non-Road Mobil Sources "Small Engines"

4.30.5.1 Introduction and Methodology

Emissions were extrapolated from previous TNRCC work. Montgomery County was determined to be similar to the study area of the seven counties. Emission estimates were calculated based upon population ratios between the example county and the seven counties referenced above times the emissions for that category in Montgomery county. Pleasure craft-boat, emissions were an exception.

County Populations 1996

County	Population
Gregg	19900
Harrison	20522
Rusk	6399
Smith	13365
Upshur	18680

Other estimation methods were considered including the new draft version of a NON-Road Model developed by EPA for the small engine category. Activity data has not been developed that are county specific. Therefore the use of previous studies that are Texas specific were used to characterize the non-road emissions. A partial list of this category includes: farm equipment(tractors, combines, pumps), construction equipment(dozers, graders, cranes, compactors), and residential equipment(lawnmowers, edgers, trimmers), and recreational equipment (4-wheelers, etc.). This is a very broad category and includes all combustion emissions from vehicles and equipment that is not registered to operate on Texas roads and highways. The population table above was used to develop a ratio of the population of the case study and the county of interest. For each category the tons per year and the tons per day for VOC, NOX, and CO were calculated.

For freshwater lake pleasure craft emissions data was obtained on area lake size in acres from the Texas Parks and Wildlife for the lakes in the core counties. Each counties lake area was divided by Montgomery County lake area (19734 acres). Emission estimates were calculated based upon lake size ratios between the referenced counties above to Montgomery County, times the emissions for that category in Montgomery county.

East Texas Lake Areas

County	Lake Area acres
Gregg	535
Harrison	14988
Rusk	6366
Smith	16408
Upshur	8803

5.0 Documentation for the 1996 National Emission Trends Emission Inventory for On-Road Mobile Sources in Texas

This section of the emission inventory report was prepared by the Area and Mobile Source Assessment Section, Texas Natural Resource Conservation Commission, September 16, 1998.

5.1 Introduction

The Texas Natural Resource Conservation Commission contracted with the Texas Transportation Institute (TTI) in 1997-1998 to provide on-road emission inventories for all 254 counties in Texas (Contract #9880066900). Under our contracts with near-nonattainment areas under Rider 17 to the agency's General Appropriations Act, we allow local districts covered by Rider 17 contracts to use the TTI's data in lieu of locally-generated mobile source inventories. This section describes and clarifies how the TTI's 1996 inventory was compiled, explaining its general methodology. Most of this write-up was abstracted from the TTI, 1998: *Memo from George Dresser to Sam Wells*. "Prepare and Document 1996 Periodic Emissions Inventories for Texas Counties." TTI Study No. 402031. February 2, 1998. This document is available for inspection or copying by contacting Mr. Wells at (512) 239-1000.

This section discusses the ajor components that make up the MOBILE modeling: vehicle miles of travel, vehicle registrations, county speeds, vehicle population mixes, and environmental data such as temperature and fuel volatility.

5.2 Vehicle Miles Traveled (VMT)

The TTI used 1996 VMT gathered from the Texas Department of Transportation (TxDOT). The VMT is based upon data collected by TxDOT for federally-required Highway Performance Monitoring System (HPMS) reports. Since the one objective of the 1996 National Emission Trends Inventory is to obtain ozone-season emissions, the VMT had to be adjusted from September-May school year to July weekday VMT. Automatic traffic recorder (ATR) data was used to do this correction, using 91 ATR stations to represent all 25 TxDOT regional averages and, hence, all 254 Texas counties. The ATRs are machines that record axles when a vehicle drives over the sensor in the pavement.

5.3 Vehicle Registrations

Vehicle registrations were obtained from the TxDOT. Since 1996 registration information was not available, 1997 registrations were used. The MOBILE5a_h model, a regulatory model required by the U.S. Environmental Agency to estimate on-road emission factors, uses 25 years of vehicle registrations. Any vehicles older than 25 years are aggregated in the 25th model year. For each vehicle type, each model year is treated as a fraction of the

sum of all vehicles in its class. Every county in Texas therefore had unique registration distributions.

5.4 County Speeds

Roadway speeds are a function of VMT, distance in centerline miles, roadway classification, and volume to capacity ratios. Every roadway classification, such as highways or local streets, has a theoretical capacity, which, when exceeded, results in congested speeds due to delay. The TTI uses a logit-type delay equation devised by the North Central Texas Council of Governments. The equation takes into consideration the direction of the roadway, called directional split. The TTI then combined each roadway classification's directional freeflow and congested speeds to obtain a county average for twelve roadway classifications. The roadways, each having a unique speed within each county, are:

- rural interstates,
- rural principlal arterials
- rural minor arterials
- rural major collectors
- rural minor collectors
- rural locals
- urban interstates
- urban other freeways
- urban principal arterials
- urban minor arterials
- urban collectors
- urban locals

5.5 VMT Mix

The MOBILE model is extremely sensitive to whether a vehicle is powered by gasoline or diesel, yet state and federal classification schemes do not record fuel type. Therefore, significant work was undertaken by TTI to allocate 8 vehicle classifications from the Federal Highway Administration's 13 vehicle types. Motorcycles are not directly counted but are assumed to be one tenth of one percent of the total fleet in a given county (0.001). The eight MOBILE vehicle types, which varied for every county, are:

- light-duty gasoline vehicle (LDGV)
- light duty gasoline trucks 1 (LDGT1)
- light-duty gasoline trucks 2 (LDGT2)
- heavy-duty gasoline vehicles (HDGV)
- light-duty diesel vehicles (LDDV)

- light-duty diesel trucks (LDDT)
- heavy-duty diesel trucks (HDDV)
- motorcycles (MC)

5.6 Environmental Inputs to the MOBILE model

Operating modes, which record the amount of VMT in cold or hot starting periods, used default MOBILEa_h model settings. The ambient temperatures were specified by the agency and used by the TTI. Minimum, maximum, and ambient temperatures were obtained from 30-year climactic data compiled from the National Weather Service using a blend of June, July, and August data, as is recommended by the EPA's procedures document regarding the National Emission Trends inventory. Texas was divided into six regional areas to define geographic differences in the climactic temperatures used in the MOBILE model.

Gasoline fuel volatility, also called RVP, was assumed to be 8.2 pounds per square inch, drawing from National Institute for Petroleum Energy Resources data for 1996. There is some variation in RVP between the six regions but the differences were not significant. Reformulated gasoline was not used except in Dallas and Houston ozone nonattainment areas; these areas were estimated only to test the robustness of TTI's methodology - these areas have their own "link-based" model as explained in following sections.

5.7 Conclusion: General Procedures Used

Eight emission factors were multiplied by twelve VMTs for each county, so there was a maximum of 96 data points for each pollutant and every county in Texas. Some counties did not have urban roadways, so fewer data points were recorded. This methodology should be distinguished from procedures used in Houston and Dallas, where every roadway segment has its own separate MOBILE run. This is called the "link-based" approach, which may have as many as 30,000 links in a given planning area. Since attainment counties do not have transportation models conducive to link-based modeling, a simpler, generalized method was employed. We call this the "HPMS method." Nonetheless, the TTI's innovative method is one of the better applications of the MOBILE model used in the United States.

5.8 Programs and Electronic Files

The TTI designed a special computer job control language (JCL) to program the VMT, speeds, and MOBILE emission factors. The JCL is a FORTRAN program which contains subroutines for preparing the information (PREPIN), invoking VMT (HPMS96TF), incorporating registration distributions (AGEDIST3), and doing the computation of emissions (IMSUMB); other subroutines are also involved but these are the chief ones. In IMPSUMB, special consideration is given to evaporative hydrocarbon emissions called diurnals.

Finally, each county has emission values for volatile organic compounds (VOC), carbon monoxide (CO), and oxides of nitrogen (NO_x). The TTI's master file contained additional information for evaporative VOCs. County emissions were reported in pounds per ozone season weekday. Area and Mobile Source Assessment Section staff reformatted this master list into a database based on the 1997 National Emission Trends inventory for mobile sources (by Pechan & Associates). Units are reported in tons per standard ozone season weekday for 1996. Detailed or summary information can be obtained by contacting the contract representative at the telephone number mentioned in the Introduction.